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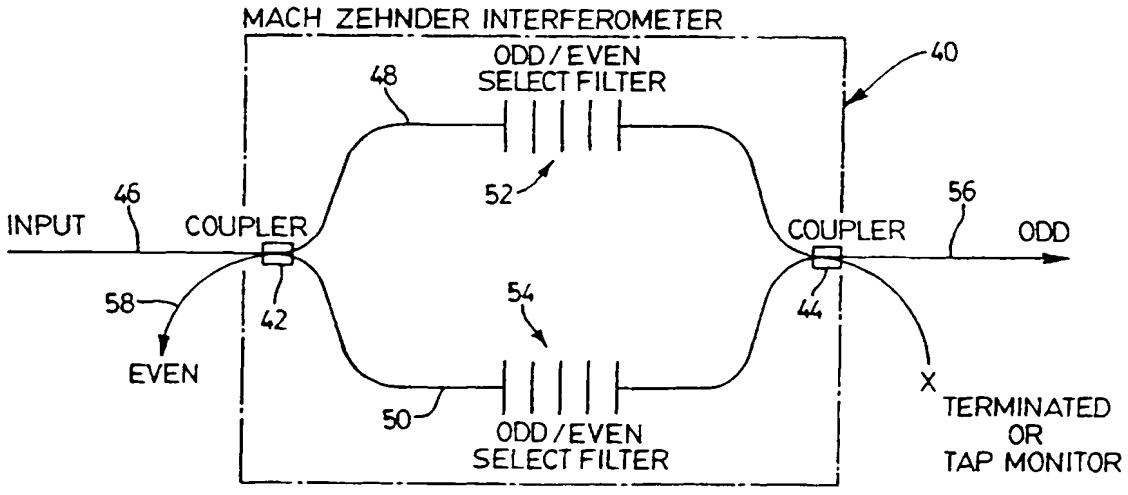
(54) **Title:** METHOD AND DEVICES FOR MULTIPLEXING AND DE-MULTIPLEXING MULTIPLE WAVELENGTHS



(57) **Abstract:** The present invention provides a method for separating or combining a plurality of wavelengths in a WDM fiber optic system. This technique can be used in a variety of ways to more readily fabricate multiplexers and de-multiplexers using both multilayer thin film or fiber Bragg grating filters or a combination thereof. The invention can also be used, in part, to fabricate an odd/even channel separator to facilitate the use of wider bandwidth filters in applications where narrow bandwidth filters are required.

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METHOD AND DEVICES FOR MULTIPLEXING AND DE-MULTIPLEXING MULTIPLE WAVELENGTHS

FIELD OF THE INVENTION

The present invention relates to a device and system for separating or combining a plurality of wavelengths in a wavelength division multiplexed fiber optic system.

BACKGROUND OF THE INVENTION

The growth of communication systems using optical signals is currently growing at an unprecedented rate and is quickly replacing more conventional electronic means of communication. A major advantage of optical communication over electronic modes transmission is the immunity of the former to electromagnetic interference. The need for high speed transmission of more information along optical waveguides such as optical communication fibers requires more efficient use of the available bandwidth.

A very powerful method of transmitting large amounts of information presently employed is wavelength division multiplexing (WDM). In this method several data streams are transmitted as an aggregate stream (multiplexed) along the optical waveguide. Each of the data channels transmits its information at its unique allotted wavelength. After the information carrying the optical signals at the different wavelengths traverses the fiber a predetermined distance, it passes through an optical de-multiplexer where the individual wavelengths are separated. The most common technique for constructing such devices is to use a series of band pass filters specially staggered to separate or combine the channels so as to incur minimum loss of the optical energy at each wavelength.

One cost effective approach for making these band pass filters is to use multilayer thin film technology. Thin film filters can be designed and subsequently packaged such that light of desired wavelength passes through and all others are reflected. For practical fiber optics applications, these types of filters are typically packaged with lenses so that light from an input fiber can be brought to the filter and the corresponding transmission and reflection can subsequently be collected with two output fibers. Since thin film filters are made on large glass substrates, this approach lends itself to low cost mass production.

However, as the channel spacing decreases from 200GHz to 100GHz and beyond, it becomes increasingly more difficult to manufacture the multilayer thin film filters necessary to separate or combine the tightly spaced channels.

Thin film filters offer the most economical approach to multiplexing and de-multiplexing optical signals that are separated by 200 GHz (1.6 nm) or more. However, as the need for greater bandwidth persists, system designers are looking to use tighter channel spacing in order to satisfy this burgeoning requirement in bandwidth. In fact, systems with channel spacing of 100 GHz (0.8 nm), and 50 GHz (0.4 nm) have been designed and are being deployed in limited numbers. Manufacturing of thin film filters for these more demanding applications is inherently difficult as yields tend to fall rapidly with tighter channel spacing.

United States Patent No. 6,040,932 issued to Duck et al. discloses a method for decomposing a composite signal into its odd and even components. Specifically, they have shown that by using a multiple of Fabry-Perot filters of different periodicity in conjunction with multiport circulators, it is possible to separate the original signal into its constituent odd and even members through a complex optical circuit. This is fundamentally different than what we show which relies on the use of a uniquely designed fiber grating employed in a simple optical circuit to accomplish the same. Our approach, however, uses fewer components and is much simpler to construct.

United States Patent No. 5,652,814 issued to Pan et al. describes a flexible coupler filter combination which when used in a tree structure can also be used to decompose a composite optical signal. This approach is, however, mainly based on using long pass thin film filters and separating the initial signal into two parts of short wavelength and long wavelength consecutively until the light signal is completely decomposed into its constituent members, i.e., $\lambda 1$, $\lambda 2$, ..., λn. This approach does not, however, provide a means for splitting the input optical signal into its odd and even components. These components could further be decomposed, or composed if used as a combiner, using standard demultiplexers. In addition, the inventors approach is limited to using thin film filters which tend to exhibit a much shallower transition from stop to pass as is suggested in the patent. In other words, the utility of the invention will be limited to channels that are not too closely spaced to one another. Our approach on the other hand utilizes periodic fiber gratings, i.e., sampled gratings, chirped moire

gratings, which can provide excellent rejection properties even for very closely spaced channels.

United States Patent No. 5,825,520 issued to Huber is directed to optical demultiplexers with grating reflectors de-multiplexing the input signal. However, this method requires a set of three gratings and a four port circulator for every two channels. In addition, the inventors have failed to recognize the limitation of their invention in that it is strictly limited to using fiber gratings and does not provide any upgradeability. In our case, the odd/even channel separator can be used in conjunction with conventional thin film filter devices to yield a hybrid filtering device superior in both performance and cost.

It would be very advantageous to provide a method and device for separating an optical signal having closely spaced channels into at least its even and odd wavelength components.

SUMMARY OF THE INVENTION

The present invention relates to a method and devices for separating or combining multiple wavelengths in an optical system. The present invention may be used in a variety of ways to more readily fabricate multiplexers and de-multiplexers using both multilayer thin film or fiber Bragg grating filters or a combination thereof. The invention can also be used, in part, to fabricate an odd/even channel separator to facilitate the use of wider bandwidth filters in applications where narrow bandwidth filters are required.

In one aspect of the invention there is provided a device for multiplexing and de-multiplexing multiple wavelengths in optical signals, comprising:

a first waveguide and an optical branching means optically connected to said first waveguide, at least second and third waveguides optically coupled to said optical branching means; and

at least one odd/even select filter optically coupled to said optical branching means for splitting an optical signal launched into said first waveguide into its odd and even wavelength components with one of said odd and even wavelength components being transmitted along one of said at least second and third waveguides and the other of said odd and even wavelength components being transmitted through the other of said at least second and third waveguides.

In another aspect of the invention there is provided an optical filter device

for multiplexing and de-multiplexing an optical signal having multiple wavelengths, comprising:

a first waveguide and an optical branching means optically connected to said first waveguide, at least second and third waveguides optically coupled to said optical branching means; and

at least one odd/even select filter optically coupled to said optical branching means for either

i) splitting an optical signal launched into said first waveguide into its odd and even wavelength components with one of said odd and even wavelength components being transmitted along one of said at least second and third waveguides and the other of said odd and even wavelength components being transmitted through the other of said at least second and third waveguides; or

ii) combining optical signals launched into said second and third waveguides with said combined optical signals being transmitted along one of said first waveguide.

BRIEF DESCRIPTION OF THE DRAWINGS

The method and devices for multiplexing and de-multiplexing a plurality of wavelengths forming the present invention will now be described, by example only, reference being had to the accompanying drawings, in which:

Figure 1 is a block diagram illustrating the function of the odd/even channel select filter constructed in accordance with the present invention;

Figure 2a is a spectrum plot of a chirped Moire grating;

Figure 2b is a spectrum plot of a modified chirped Moire grating to flatten regions of varying index and create multiple band pass filters with in the overall stop band of the filter;

Figure 3 is a block diagram of an optical circuit which includes a circulator as the optical branching device;

Figure 4 is a block diagram of an optical circuit constructed in accordance with the present invention using a pair of couplers in a Mach-Zehnder interferometer arrangement in order to separate the odd and even channels without using a circulator;

Figure 5a is a block diagram of an alternative embodiment of an optical circuit which includes a coupler as the optical branching device;

Figure 5b is a block diagram of another alternative embodiment of an

optical circuit which includes a coupler as the optical branching device;

Figure 6 is a diagram of the filter assembly cascaded to allow for complete separation of part or all channels; and

Figure 7 shows the odd/even channel select filter in a generic form coupled to an array of thin film filters with reduced channel separation for full decomposition of all the input channels.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to Figure 1, the present invention embodies the use of an odd/even channel select filter 10 together with a fiber optic branching device to reduce the overall channel density and allow the use of lower grade filters for multiplexing and de-multiplexing of optical signals. This approach can be used in a sequential manner to reduce or increase the channel density by using specially fabricated odd/even channel filters with varying bandwidth. In other words, the highest density optical signal is broken up into its odd and even components and they, in turn, are broken up to odd and even components until all channels have been separated. Alternatively, the approach may be used to reduce the channel density and then use one of many conventionally used approaches to further separate the channels.

The method and system for multiplexing or demultiplexing optical signals disclosed herein may be implemented using waveguides for example semiconductor waveguides or optical fibers through which optical signals to be processed propagate.

The method forming the present invention allows for separating closely spaced optical channels by dividing the input signal into two output signals. The two outputs form odd and even signal paths such that the resulting channel density of each of the two outputs is at most half as much as the original signal. The odd/even filter 10 according to the present invention comprises an odd/even select channel filter together with an optic branching device to form two outputs or output ports each of which is at most half as densely populated as the original signal.

The odd/even channel select filter may be a chirped Moire Bragg grating, a sampled grating, a chirped sampled grating, a co-located grating or a series of individual gratings spaced along the waveguide. These channel select filters may be produced in optical fibers or produced in a semiconductor waveguide

chip.

Specifically, a preferred odd/even channel select filter grating is a chirped Moire fiber Bragg grating whose index modulation has been selectively erased at specific locations. A chirped Moire grating consists of two superimposed linearly chirped Bragg gratings, see Figure 2a. Designing the filter appropriately creates a comb like structure with flat top band pass structures in the optical spectrum. Combining this filter with a fiber optic branching device such as a fiber optic circulator or coupler would allow separating the signals into odd and even as formed by the comb like filter. In other words, every other channel would go through such a filter while every other channel, offset by one channel, would be reflected. In this way the reflected and transmitted channels will form the odd and even parts respectively of the initial signal.

Figure 2b(i) shows the spectrum of a chirped Moire grating whose index modulation has been erased in the middle creating the opening or band pass as shown. Figure 2b(ii) and 2b(iii) show the flexibility of the design in obtaining a variety of different responses.

In one preferred embodiment of the invention a specially modified chirped Moire fiber grating is used as the odd/even channel select filter. Formation of a chirped Moire fiber grating creates a wide stop band in the transmission spectrum as prescribed by the characteristics of the fiber, its index of refraction, and the chirp pattern. Chirped Moire gratings have spike like features in their overall stop band. These features are repeated periodically which by design creates a simple and elegant fix on the wavelength grid. Washing out certain regions of the index modulation, or stated in another way, erasing the grating in specific locations, in the chirped grating pattern simply creates the desirable flat top openings in the spectrum.

Referring to Figure 3, a device for multiplexing or demultiplexing multiple wavelengths using the aforementioned chirped Moire grating is shown at 20. The optic branching device comprises a three-port circulator 22 comprises an input fiber branch 24 along which the light signal containing the wavelengths to be separated propagates, a fiber branch 26 containing a chirped Moire grating filter 28 as discussed above with the output of filter 28 containing the odd wavelengths, and an output branch 30 through which the even wavelengths reflected from grating 28 are output. The circulator 22 is an optical fiber based component while the odd/even select filter 28 and the waveguide branches 24,

26 and 30 may be produced using optical fibers or produced on a waveguide chip.

In some applications it may be preferred to use a directional coupler for separating the odd and even channels such as illustrated in Figures 5a and 5b. In one embodiment of this arrangement, shown generally at 60 in Figure 5a, a directional coupler 64 is used to initially divide the input signal which is output from an isolator 62. An odd/even channel select filter 68 is used to pass the odd wavelengths through arm 70 output 2 and at the same time reflect the even wavelengths back through arm 72 to output 1 (or vise verse where even wavelengths are transmitted through filter 68 and odd wavelengths are reflected back through arm 72. The purpose of isolator 62 is to stop the reflection generated from the filter from returning to the input. This is quite important since any unwanted reflections in the opposite direction may result in instabilities back at the transmitter which would ultimately reduce overall system performance.

Referring to Figure 5b, in an alternative embodiment of the device shown generally at 80 the second arm 76 of the coupler 64 can be used where each of the two output arms 70 and 76 of the coupler 64 are outfitted with single or multiple channel select filters 68 and 72 respectively offset in each arm to allow the passage of even channels through arm 70 and odd channels through the other arm 76. In this configuration the channel select filter 68 passes the odd wavelengths and blocks even wavelengths (or vise verse) and channel select filter 74 passes even wavelengths and blocks odd wavelengths (or vise versa). This approach has the benefit that the power in odd and even channels as a result of the separation remains relatively the same. However, device 80 requires two filters each placed in one arm of the filter as opposed to the arrangement shown in Figure 5a which requires only one. The devices in Figures 5a and 5b may be fabricated into a chip containing the waveguides with the exception of the isolators 62 which are fiber based components.

Another embodiment of the device constructed according to the present invention is shown in Figure 4 and comprises a fiber optic Mach-Zehnder interferometer 40. Interferometer 40 includes two couplers 42 and 44 with the fiber 46 carrying the input light signal connected to coupler 42. The interferometer includes two arms 48 and 50 each containing two identically fabricated filters 52 and 54 respectively to separate the odd and even channels. The couplers 42 and 44 are used to combine the portions of the light that

interfere with each other as a result of the interferometer arrangement which allows the constructive and destructive parts of the interference to be separated with minimal loss to the optical energy. The odd wavelengths are output through fiber 56 connected to coupler 44 and the even wavelengths are output through fiber 58 connected to coupler 42.

Figure 6 shows an example of using the odd/even channel select filters by using any of the arrangements described hereinafter to separate all the wavelengths of an incoming signal. In these embodiments shown in Figure 6 the box-like elements represent odd/even filters used for the separation of the odd and even channels. The filter device in Figure 6 is used to demultiplex (or multiplex if used in reverse) an optical signal having n wavelengths. The wavelength filter device includes in total n-1 of the three port odd/even filter devices optically coupled in a cascaded series in which the two outputs of each odd/even filter forms an input port for two subsequent filter devices in the cascaded filter series. The individual wavelengths $\lambda 1, \lambda 2, \ldots, \lambda n$ are each output from the outputs on the last odd/even filters in the cascaded array or series. Each of the odd/even filter devices in the cascaded series in Figure 6 may be constructed as described with respect to Figures 3, 4, 5a or 5b.

Figure 7 shows the odd/even channel select filter in a generic form coupled to an array of thin film wavelength filters with reduced channel separation for full decomposition of all the input channels. This design has the advantage of using the fiber grating based odd/even channel select filter for reducing the channel density, while using the excellent properties of the thin film filter for final separation. United States Patent Nos. 6,067,178 and 5, 652,814, which are incorporated herein by reference, disclose how to demultiplex optical signals using thin film filters in the embodiment in Figure 7.

In one such arrangement, a widely chirped fiber grating with regions of constant index or a sampled fiber grating which consists of periodic regions of varying index and constant index can be used as the odd/even channel select filter. In the former, a widely chirped, spectrally broad, grating is holographically written into the core of an optical fiber which is subsequently exposed to dc UV radiation at the appropriate wavelength which creates regions of constant index in pre-selected locations. This effectively creates a chirped sampled grating whose spectrum will also have a comb-like structure. The main difference between a chirped sampled grating and a chirped Moire grating is the absence

of the spike like features in the spectrum for Moire gratings. These features can be used to provide an absolute fix in the wavelength spectrum. In other words, chirped Moire gratings whose index has been erased at pre-selected locations facilitate aligning the filter to the exact wavelength grid. On the other hand, sampled gratings are easier to manufacture so the final decision in respect of which filter to use will largely depend on the application. In addition, due to the nature of the grating formation, it may be beneficial to use the chirped Moire grating for obtaining better insertion loss.

In a variation of this embodiment, several co-located gratings are fabricated in the fiber which forms the comb like filter as described in the previous two embodiments. Co-located gratings are fiber gratings fabricated in the same physical location in the optical fiber. The advantage to making co-located gratings as opposed to individual gratings which are subsequently spliced together is the ability to package them in an athermal arrangement with significant space savings. An athermal grating is a packaged grating in a mechanical or thermal arrangement such that the characteristic thermal sensitivity of the grating's center wavelength is neutralized as described in US Patent No. 5,042,898 and incorporated herein by reference. This arrangement allows for a great deal of flexibility as any combination of filter shape and structure is possible through fabrication of these individual gratings which are co-located.

It will be understood that while the wavelength filter device disclosed herein has been illustrated for demultiplexing an optical signal with multiple wavelengths, it can just as easily be used as a multiplexer by using the outputs as inputs in which individual wavelengths are input into the outputs with a multiplexed signal being output at the first odd/even filter in Figure 6 or 7.

Thus, the foregoing description of the preferred embodiments of the invention has been presented to illustrate the principles of the invention and not to limit the invention to the particular embodiment illustrated. It is intended that the scope of the invention be defined by all of the embodiments encompassed within the following claims and their equivalents.

THEREFORE WHAT IS CLAIMED IS:

1. An optical filter device for multiplexing and de-multiplexing multiple wavelengths in optical signals, comprising:

a first waveguide and an optical branching means optically connected to said first waveguide, at least second and third waveguides optically coupled to said optical branching means; and

at least one odd/even select filter optically coupled to said optical branching means for splitting an optical signal launched into said first waveguide into its odd and even wavelength components with one of said odd and even wavelength components being transmitted along one of said at least second and third waveguides and the other of said odd and even wavelength components being transmitted through the other of said at least second and third waveguides.

2. The filter device according to claim 1 or 17 wherein the optical branching means is a fiber optic circulator and said at least one odd/even select filter transmits one of said odd and even components along one of said at least second and third waveguides and reflects the other of said odd and even wavelength components through the other of said at least second and third waveguides.

3. The filter device according to claim 1 or 17 wherein the optical branching means is an optical coupler and said at least one odd/even select filter means is one filter optically coupled to one of said second and third waveguides, and wherein said at least one odd/even select filter transmits one of said odd and even components along one of said at least second and third waveguides and reflects the other of said odd and even wavelength components through the other of said at least second and third waveguides.

4. The filter device according to claim 3 including a fiber optical isolator optically coupled to said first waveguide to prevent reflections from said filter from returning to said first waveguide.

5. The filter device according to claim 1 or 17 wherein the optical branching

means is an optical coupler and said at least one odd/even select filter means includes a first filter means optically coupled to said second waveguide for transmitting one of said odd and even wavelength components along said second waveguide and a second filter means optically coupled to said third waveguide for transmitting the other of said odd and even wavelength components along said third waveguide.

6. The filter device according to claim 5 including a fiber optical isolator optically coupled to said first waveguide to prevent reflections from said first and second filter means from returning to said first waveguide.

7. The filter device according to claim 1 or 17 wherein the optical branching means is two optical couplers and said at least one odd/even select filter means is a first filter means located in a fourth waveguide optically coupled to said two optical couplers and a second filter means located in a fifth waveguide optically coupled to said two optical couplers in parallel with said first optical fiber, said second waveguide being optically coupled to one of said two optical couplers and said third waveguide being optically coupled to the other of said two optical couplers.

8. The filter device according to claim 7 wherein said two optical couplers are two fiber optical couplers.

9. The filter device according to claim 1 wherein said optical signal includes n wavelengths, and wherein said filter device is a first three port filter device, including n-1 in total of said three port filter devices optically coupled in a cascaded series, said second and third waveguides of each of said three port filter devices forming an input port for two subsequent filter devices in said filter series, and wherein the second and third waveguides of each of the last three port filter devices in the cascaded series each carry one of said n wavelengths so that $\lambda 1, \lambda 2, \ldots, \lambda n$ are each output from said cascaded series.

10. The filter device according to claim 1 wherein said optical signal includes n wavelengths $\lambda 1, \lambda 2, \ldots, \lambda n$, wherein said second output waveguide is connected to a first thin film wavelength filter array and said third output waveguide is connected to a second thin film wavelength filter array, each thin film wavelength array including having a least n/2 thin film filters with each thin film filter having an output port for output of one of said wavelengths.

11. The device according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 17 wherein the first waveguide and the at least second and third waveguides are optical fibers.

12. The device according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11 wherein the odd/even select filter means is a chirped Moire Bragg grating whose index modulation has been selectively erased at preselected locations.

13. The device according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11 wherein the odd/even select filter means is a sampled grating.

14. The device according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11 wherein the odd/even select filter means is a chirped sampled grating.

15. The device according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11 wherein the odd/even select filter means are co-located gratings.

16. The device according to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11 wherein the odd/even select filter means are a series of individual gratings.

17. An optical filter device for multiplexing and de-multiplexing an optical signal having multiple wavelengths, comprising:

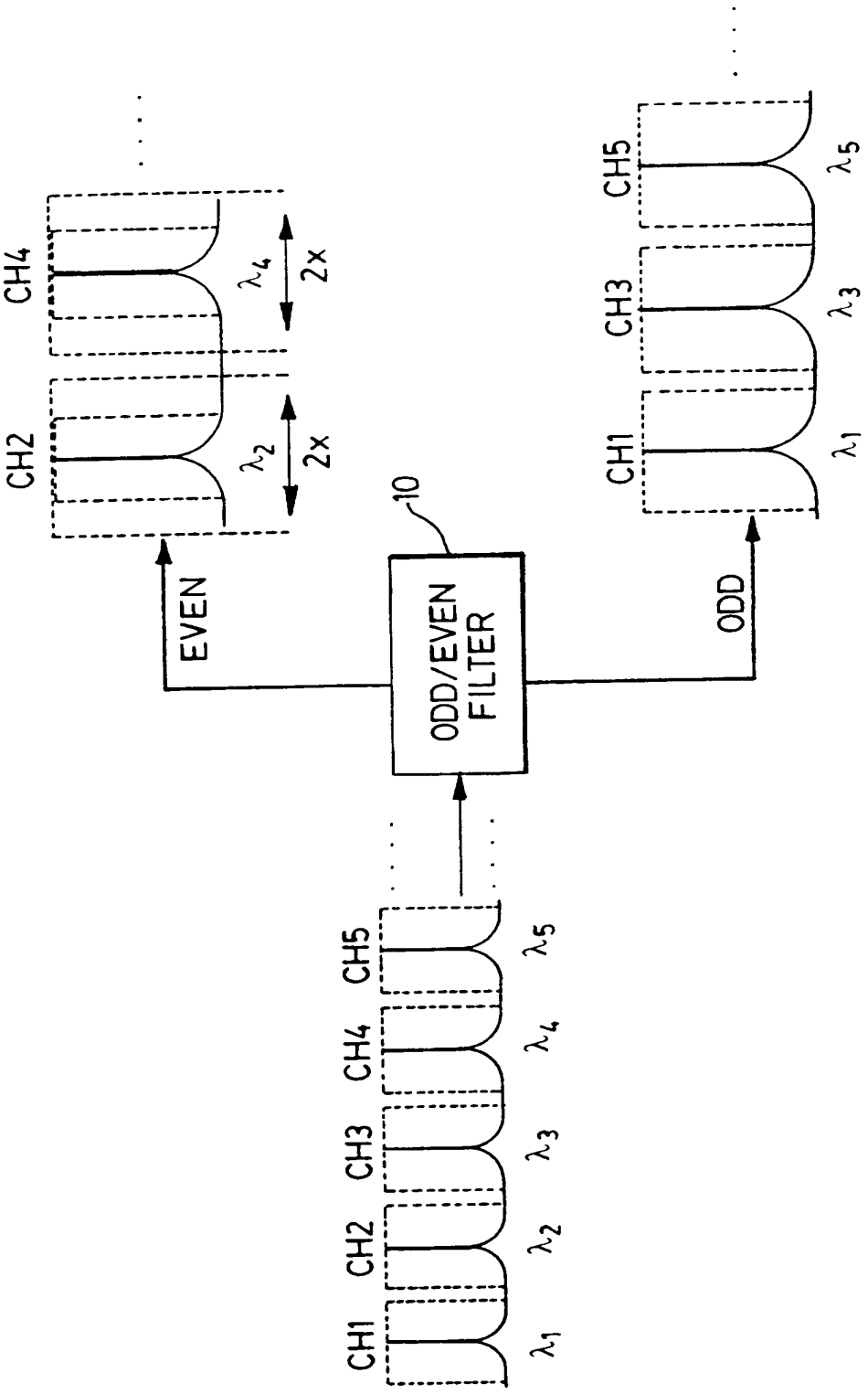
a first waveguide and an optical branching means optically connected to said first waveguide, at least second and third waveguides optically coupled to said optical branching means; and

at least one odd/even select filter optically coupled to said optical branching means for either

i) splitting an optical signal launched into said first waveguide into its odd

and even wavelength components with one of said odd and even wavelength components being transmitted along one of said at least second and third waveguides and the other of said odd and even wavelength components being transmitted through the other of said at least second and third waveguides; or

ii) combining optical signals launched into said second and third waveguides with said combined optical signals being transmitted along one of said first waveguide.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λ_4
2x
λ_2
2x
EVEN
10
ODD/EVEN FILTER
ODD
CH5
CH3
CH1
λ_5
λ_3
λ_1
CH1 CH2 CH3 CH4 CH5
λ_1 λ_2 λ_3 λ_4 λ_5

FIG. 1

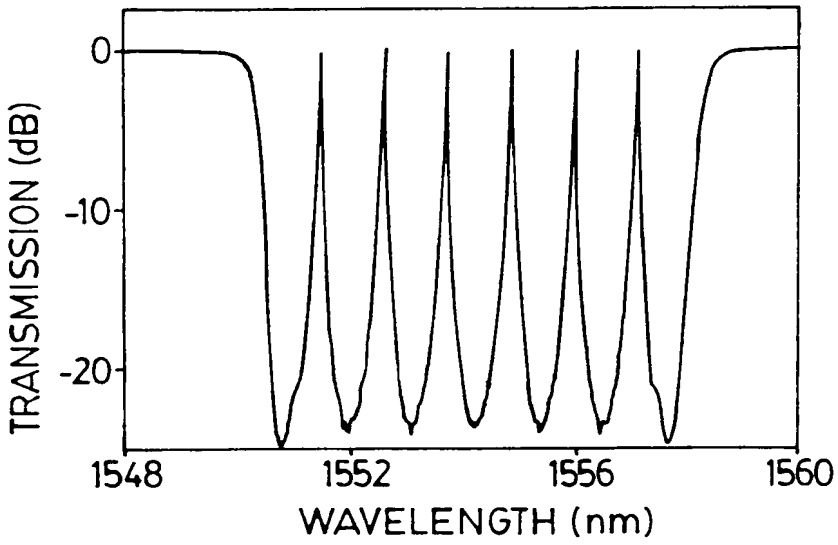


FIG. 2a

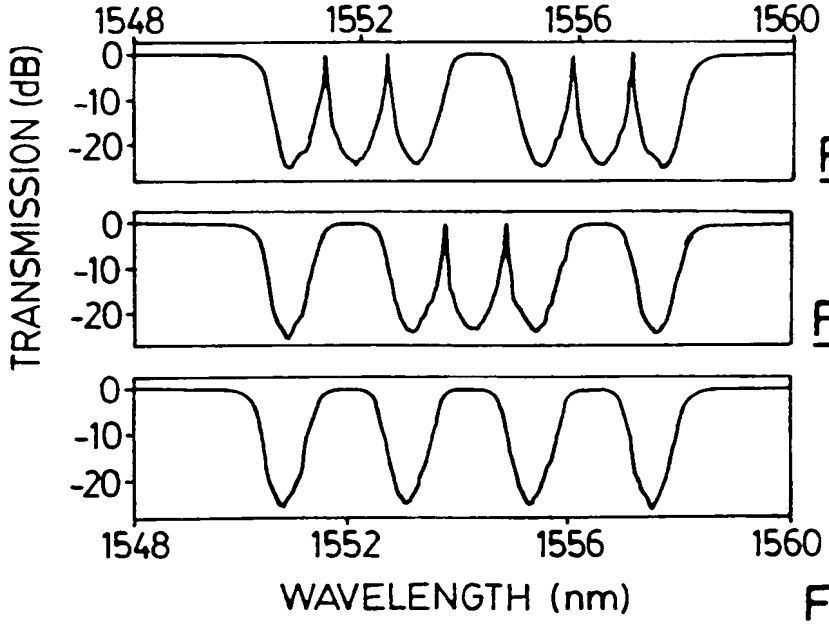


FIG. 2b(i)

FIG. 2b(ii)

FIG. 2b(iii)

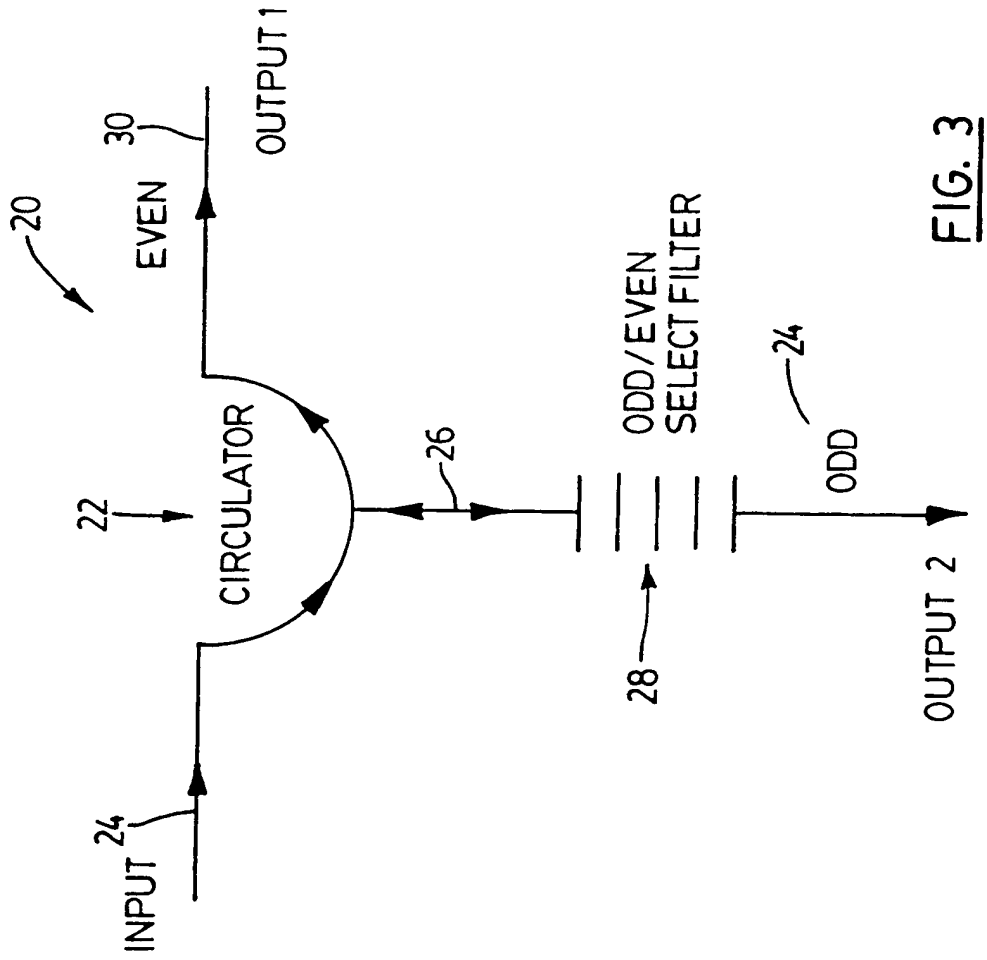
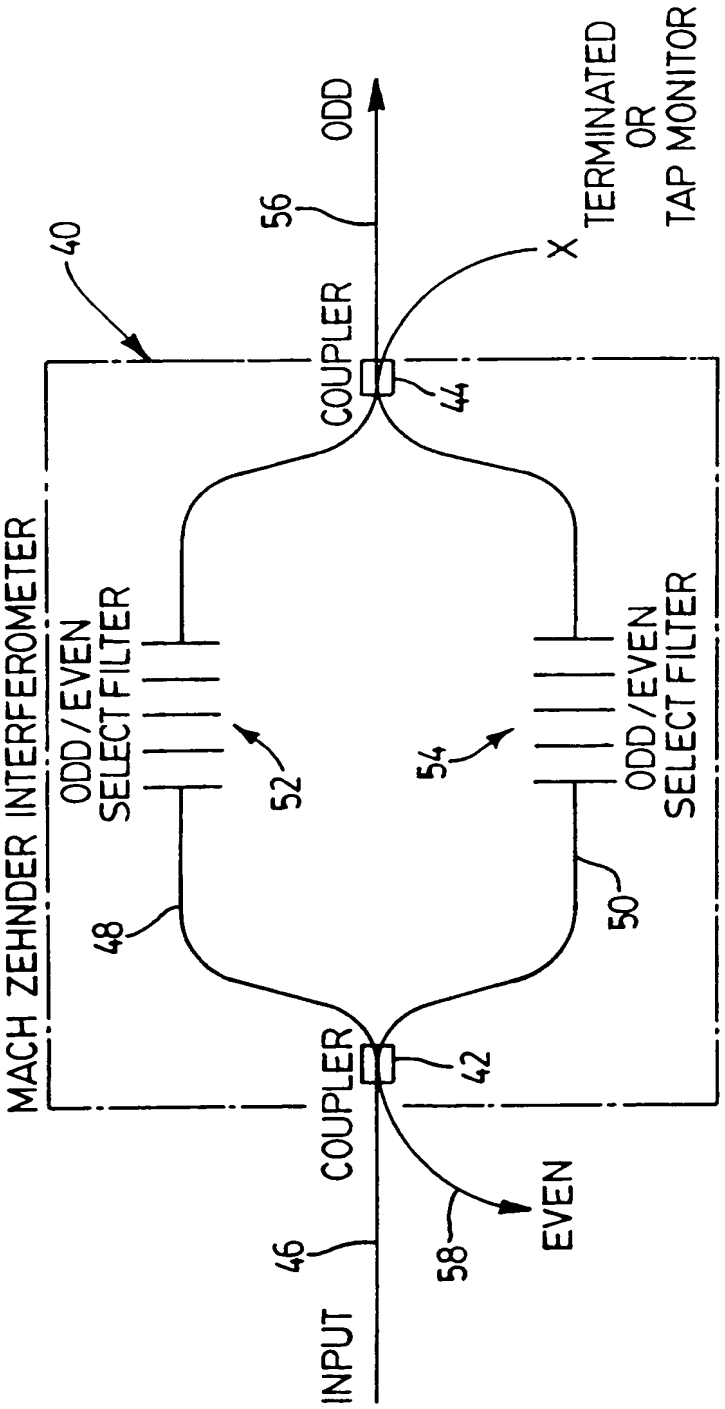

20
22
INPUT
24
CIRCULATOR
26
ODD/EVEN
SELECT FILTER
28
24
ODD
OUTPUT 2
30
EVEN
OUTPUT 1

FIG. 3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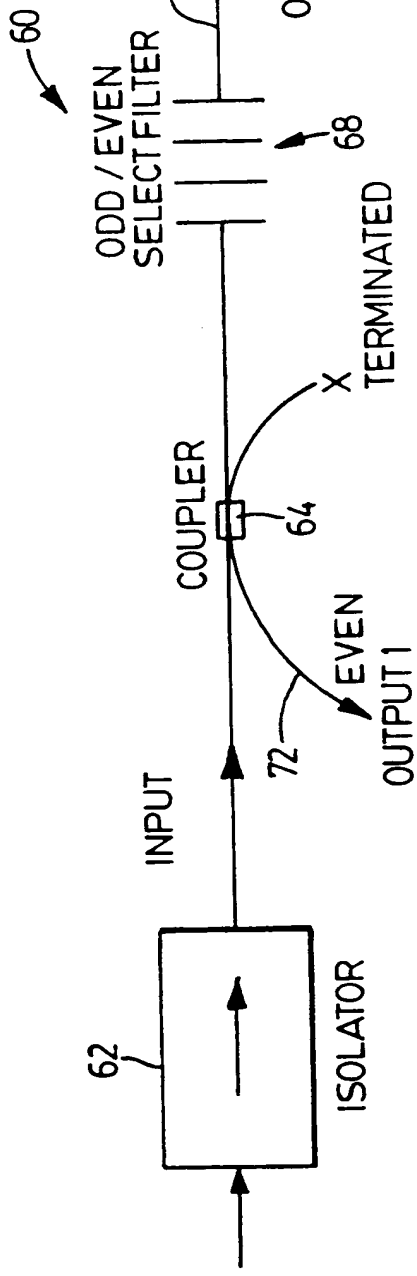
ODD/EVEN SELECT FILTER
52
54
ODD/EVEN SELECT FILTER
48
50
COUPLER
44
COUPLER
42
56
ODD
X
TERMINATED OR TAP MONITOR
46
INPUT
58
EVEN

FIG. 4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ODD / EVEN SELECT FILTER
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ODD
OUTPUT 2
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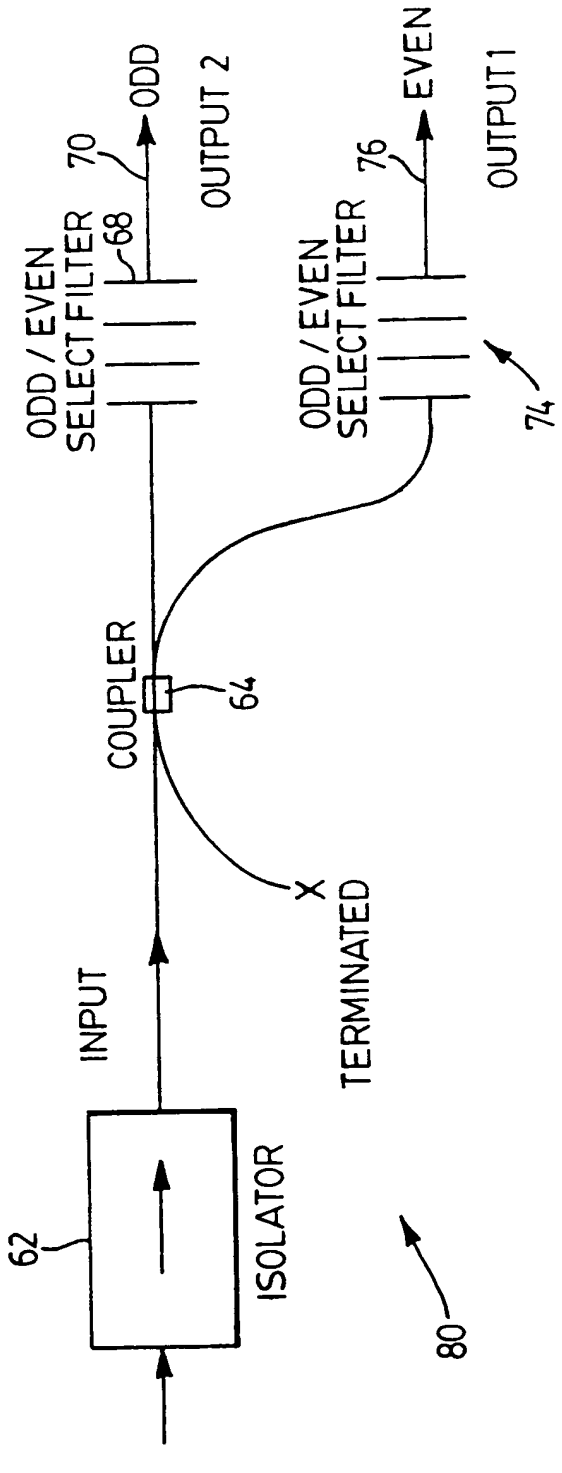
X
TERMINATED
COUPLER
64
72
EVEN
OUTPUT 1
INPUT
62
ISOLATOR

FIG. 5a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70
ODD
OUTPUT 2
68
ODD / EVEN SELECT FILTER
76
EVEN
OUTPUT 1
74
COUPLER
64
X
TERMINATED
INPUT
62
ISOLATOR
80

FIG. 5b

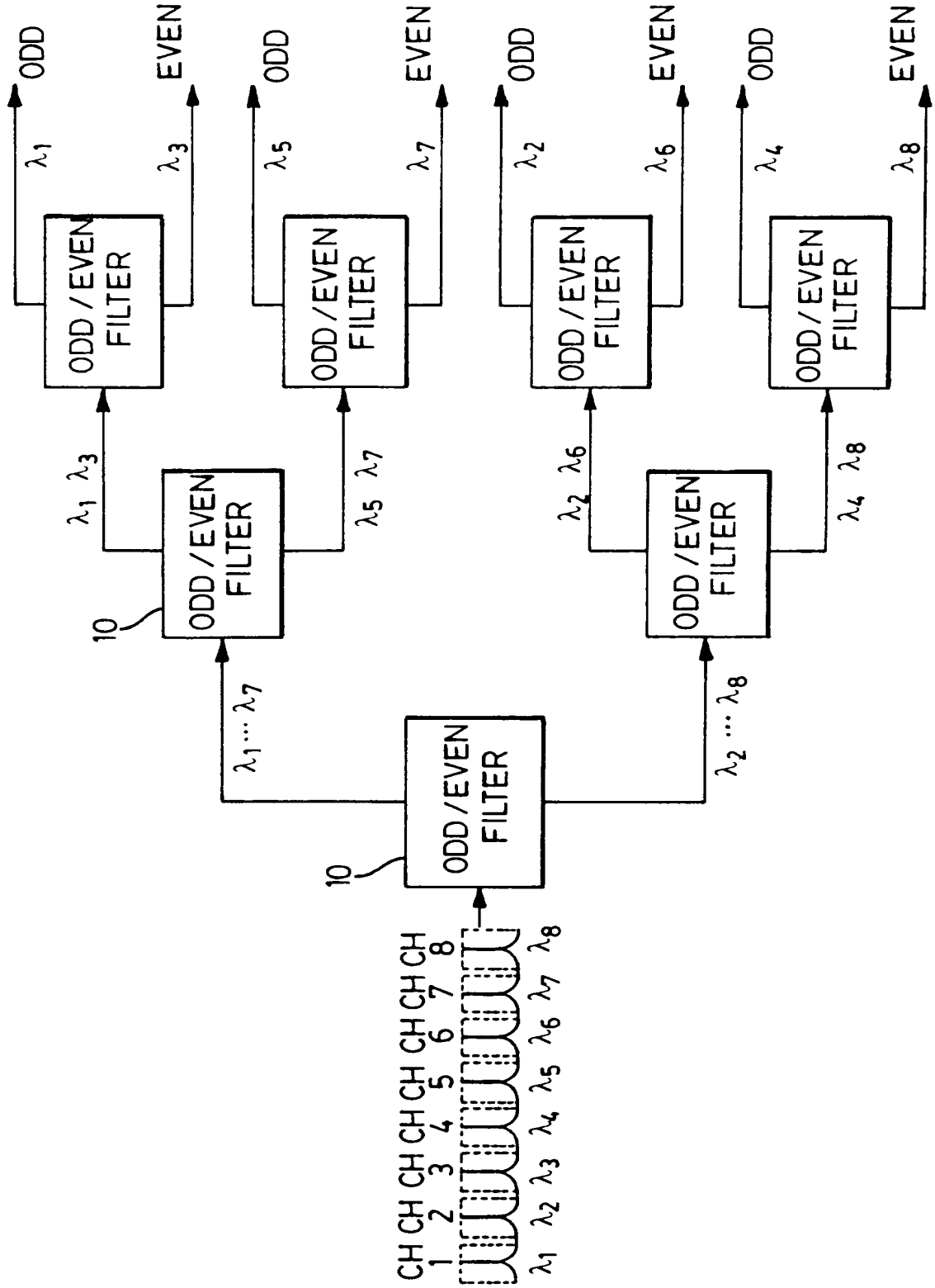
ODD
EVEN
ODD/EVEN FILTER
10
CH 1 CH 2 CH 3 CH 4 CH 5 CH 6 CH 7 CH 8
λ1 λ2 λ3 λ4 λ5 λ6 λ7 λ8

FIG. 6

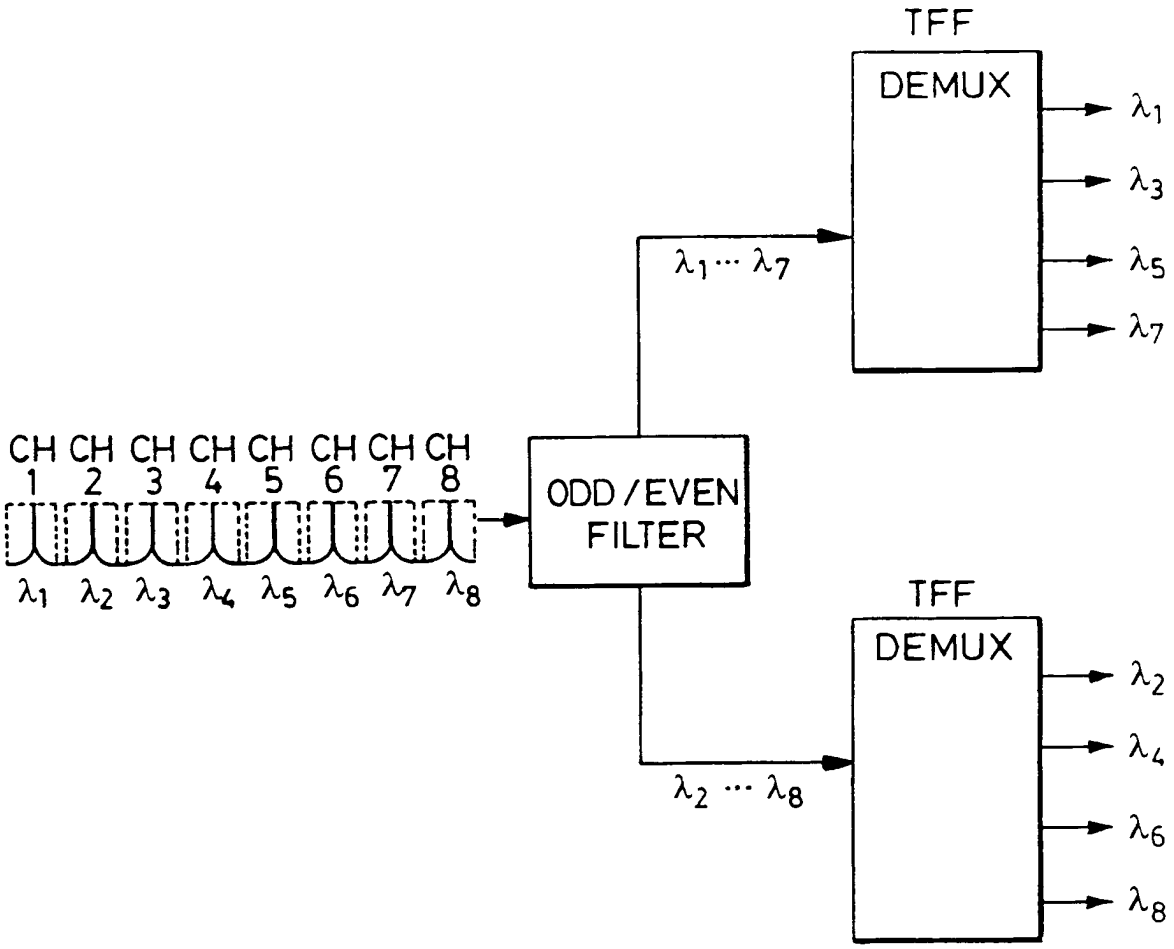
TFF
DEMUX
λ_1
λ_3
λ_5
λ_7
$\lambda_1 \cdots \lambda_7$
CH 1 CH 2 CH 3 CH 4 CH 5 CH 6 CH 7 CH 8
λ_1 λ_2 λ_3 λ_4 λ_5 λ_6 λ_7 λ_8
ODD / EVEN FILTER
TFF
DEMUX
λ_2
λ_4
λ_6
λ_8
$\lambda_2 \cdots \lambda_8$

FIG. 7

INTERNATIONAL SEARCH REPORT

Intern ıal Application No
PCT/CA 00/00813

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04J14/02 G02B6/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04J G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropnate, of the relevant passages	Relevant to claim No.
X	WO 99 13607 A (CIENA CORP) 18 March 1999 (1999-03-18) page 1, line 1 - line 2 page 3, line 9 -page 4, line 5 page 5, line 6 -page 8, line 2; figures 1-3 page 10, line 18 -page 11, line 11; figure 6 page 13, line 13 -page 14, line 11; figure 9 page 15, line 8 -page 16, line 4; figure 12 --- -/--	1-11, 15-17

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 November 2000	30/11/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Roldán Andrade, J

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Intern: ıal Application No
PCT/CA 00/00813

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 748 350 A (CAO SIMON X F ET AL) 5 May 1998 (1998-05-05) column 1, line 5 - line 9 column 1, line 44 -column 2, line 22 column 3, line 10 -column 4, line 39; figures 1A,1B column 5, line 11 -column 7, line 33; figures 3A,4A,4B column 9, line 16 -column 10, line 27; figures 9,10A,10B	1-6, 9-11, 15-17
X	WO 99 08143 A (LAMING RICHARD IAN ;UNIV SOUTHAMPTON (GB)) 18 February 1999 (1999-02-18) page 1, line 3 - line 4 page 2, line 29 -page 6, line 18 page 7, line 2 -page 9, line 24; figures 2-4	1-6,9, 11,13-17
X Y	US 5 754 718 A (CHENG YIHAO ET AL) 19 May 1998 (1998-05-19) column 1, line 4 - line 15 column 2, line 50 - line 52 column 2, line 65 -column 3, line 61 column 4, line 43 -column 5, line 33; figures 2-4 column 5, line 48 -column 6, line 25; figures 6,7	1,2,9, 11,14,17 12
P,X	WO 99 42899 A (LIGHTWAVE MICROSYSTEMS CORP) 26 August 1999 (1999-08-26) page 1, line 13 - line 19 page 2, line 15 -page 6, line 3 page 6, line 11 - line 22 page 20, line 15 - line 19 page 21, line 25 -page 23, line 3; figures 13-16	1-9,11, 13-17
Y	CHEN L R ET AL: "TRANSMISSION FILTERS WITH MULTIPLE FLATTENED PASSBANDS BASED ON CHIRPED MOIRE GRATINGS" IEEE PHOTONICS TECHNOLOGY LETTERS,US,IEEE INC. NEW YORK, vol. 10, no. 9, 1 September 1998 (1998-09-01), pages 1283-1285, XP000783231 ISSN: 1041-1135 page 1283, left-hand column, paragraph 1 - paragraph 2 page 1284, left-hand column, paragraph 2 -page 1285, right-hand column, paragraph 1; figures 3,4	12

-/--

1

INTERNATIONAL SEARCH REPORT

Intern: al Application No
PCT/CA 00/00813

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 822 095 A (MIYAKAWA TAKAYUKI ET AL) 13 October 1998 (1998-10-13) column 1, line 5 - line 12 column 2, line 64 -column 4, line 20; figures 1-3	3-6

1

INTERNATIONAL SEARCH REPORT

...ormation on patent family members

Intern... ...al Application No
PCT/CA 00/00813

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9913607 A	18-03-1999	AU 9229798 A	29-03-1999
		EP 0937347 A	25-08-1999
US 5748350 A	05-05-1998	NONE	
WO 9908143 A	18-02-1999	AU 8549598 A	01-03-1999
		EP 1004045 A	31-05-2000
US 5754718 A	19-05-1998	CA 2211781 A	26-02-1998
WO 9942899 A	26-08-1999	NONE	
US 5822095 A	13-10-1998	JP 9083495 A	28-03-1997

PATENT COOPERATION TREAT

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
148-013-P		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/CA 00/ 00813	13/07/2000	13/07/1999

Applicant

E-TEK ELECTROPHOTONICS SOLUTIONS CORPORATION

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the title,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 4

[X] as suggested by the applicant.

[ ] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

[ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 00/00813

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04J14/02 G02B6/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04J G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 13607 A (CIENA CORP) 18 March 1999 (1999-03-18) page 1, line 1 - line 2 page 3, line 9 -page 4, line 5 page 5, line 6 -page 8, line 2; figures 1-3 page 10, line 18 -page 11, line 11; figure 6 page 13, line 13 -page 14, line 11; figure 9 page 15, line 8 -page 16, line 4; figure 12 --- -/--	1-11, 15-17

[X] Further documents are listed in the continuation of box C

[X] Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search
16 November 2000

Date of mailing of the international search report
30/11/2000

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040 Tx. 31 651 epo nl
Fax (+31-70) 340-3016

Authorized officer
Roldán Andrade, J

Form PCT/ISA/210 (second sheet) (July 1998)

RNATIONAL SEARCH REPORT

International Application No
PCT/CA 00/00813

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 748 350 A (CAO SIMON X F ET AL) 5 May 1998 (1998-05-05) column 1, line 5 - line 9 column 1, line 44 -column 2, line 22 column 3, line 10 -column 4, line 39; figures 1A,1B column 5, line 11 -column 7, line 33; figures 3A,4A,4B column 9, line 16 -column 10, line 27; figures 9,10A,10B	1-6, 9-11, 15-17
X	WO 99 08143 A (LAMING RICHARD IAN ;UNIV SOUTHAMPTON (GB)) 18 February 1999 (1999-02-18) page 1, line 3 - line 4 page 2, line 29 -page 6, line 18 page 7, line 2 -page 9, line 24; figures 2-4	1-6,9, 11,13-17
X Y	US 5 754 718 A (CHENG YIHAO ET AL) 19 May 1998 (1998-05-19) column 1, line 4 - line 15 column 2, line 50 - line 52 column 2, line 65 -column 3, line 61 column 4, line 43 -column 5, line 33; figures 2-4 column 5, line 48 -column 6, line 25; figures 6,7	1,2,9, 11,14,17 12
P,X	WO 99 42899 A (LIGHTWAVE MICROSYSTEMS CORP) 26 August 1999 (1999-08-26) page 1, line 13 - line 19 page 2, line 15 -page 6, line 3 page 6, line 11 - line 22 page 20, line 15 - line 19 page 21, line 25 -page 23, line 3; figures 13-16	1-9,11, 13-17
Y	CHEN L R ET AL: "TRANSMISSION FILTERS WITH MULTIPLE FLATTENED PASSBANDS BASED ON CHIRPED MOIRE GRATINGS" IEEE PHOTONICS TECHNOLOGY LETTERS,US,IEEE INC. NEW YORK, vol. 10, no. 9, 1 September 1998 (1998-09-01), pages 1283-1285, XP000783231 ISSN: 1041-1135 page 1283, left-hand column, paragraph 1 - paragraph 2 page 1284, left-hand column, paragraph 2 -page 1285, right-hand column, paragraph 1; figures 3,4	12

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 00/00813

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
A	US 5 822 095 A (MIYAKAWA TAKAYUKI ET AL) 13 October 1998 (1998-10-13) column 1, line 5 - line 12 column 2, line 64 -column 4, line 20; figures 1-3 -----	3-6

ERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/CA 00/00813

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 9913607	A	18-03-1999	AU	9229798 A	29-03-1999
			EP	0937347 A	25-08-1999
US 5748350	A	05-05-1998	NONE		
WO 9908143	A	18-02-1999	AU	8549598 A	01-03-1999
			EP	1004045 A	31-05-2000
US 5754718	A	19-05-1998	CA	2211781 A	26-02-1998
WO 9942899	A	26-08-1999	NONE		
US 5822095	A	13-10-1998	JP	9083495 A	28-03-1997

14

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
148-013-P		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/CA00/00813	13/07/2000	13/07/1999
International Patent Classification (IPC) or national classification and IPC H04J14/02		
Applicant JDS UNIPHASE CORPORATION et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☒ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
12/02/2001	20.11.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Liebhart, M Telephone No. +49 89 2399 7598

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/CA00/00813

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-9 as originally filed

Claims, No.:

1-17 as originally filed

Drawings, sheets:

1/7-7/7 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	10,12-16
	No:	Claims	1-9, 11, 17
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-17
Industrial applicability (IA)	Yes:	Claims	1-17
	No:	Claims	

2. Citations and explanations
see separate sheet

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Reference is made to the following documents:

D1: US-A-5 748 350 (CAO SIMON X F ET AL) 5 May 1998 (1998-05-05)
D2: WO 99 13607 A (CIENA CORP) 18 March 1999 (1999-03-18)
D3: WO 99 08143 A (LAMING RICHARD IAN ;UNIV SOUTHAMPTON (GB)) 18 February 1999 (1999-02-18)
D4: CHEN L R ET AL: 'TRANSMISSION FILTERS WITH MULTIPLE FLATTENED PASSBANDS BASED ON CHIRPED MOIRE GRATINGS' IEEE PHOTONICS TECHNOLOGY LETTERS,US,IEEE INC. NEW YORK, vol. 10, no. 9, 1 September 1998 (1998-09-01), pages 1283-1285, XP000783231 ISSN: 1041-1135

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Document D1 (see abstract, Fig. 1A and 1B) discloses (the references in parentheses applying to this document) in accordance with the features of claim 1

an optical filter device for multiplexing and demultiplexing multiple wavelengths in optical signals, comprising

a first waveguide (10, 20) and an optical branching means (13, 23) optically connected to said first waveguide, at least second (12, 22) and third (11, 21) waveguides optically coupled to said optical branching means; and at least one odd/even select filter (16, 26) optically coupled to said optical branching means for splitting an optical signal launched into said first waveguide into its odd and even wavelength components with one of said odd and even wavelength components being transmitted along one of said at least second and third waveguides and the other of said odd and even wavelength components being transmitted through the other of said at least second and third waveguides (col. 3, line 9 to col. 4, line 45).

Document D1 discloses all the features of independent claim 1. Thus claim 1 is not new and does not fulfill the requirements of **Article 33(2) PCT**.

2. Furthermore it should be noted that documents D2 (see abstract and Fig. 9) and D3 (see abstract and Fig. 2) describe dense WDM optical multiplexer and demultiplexer including all the features of claim 1.

3. **The additional features of the dependent claims 2-16** are **not new (Article 33(2) PCT)** or do **not involve an inventive step (Article 33(3) PCT)**.

Fiber optic circulators as well as optical couplers as defined in claims 2 and 3 are already disclosed in D1 (abstract; Fig. 1A: 13, 1B: 23 and col. 9, lines 16-27; Fig. 9: 103).

The use of optical isolators as defined in claims 4 and 6 is well known in the art of fiber optics.

An arrangement including an optical coupler and odd/even select filter means according to claim 5 is already disclosed in D1 (col. 9, line 16 to col. 10, line 18; Fig. 9).

Claim 7 effectively describes the construction of optical demultiplexing by means of Mach-Zehnder interferometers. This is already known from the system of D2 (page 13, line 13 to page 14, line 11; Fig. 9).

With respect to claim 8, fiber optical couplers are already disclosed in D2 (page 14, lines 5-11; Fig. 10).

The use of three port filter devices coupled in a cascaded series according to claim 9 is already known from D2 (page 13, line 13 to page 14, line 11; Fig. 6 and 9).

The additional features of claim 10, i.e. thin film wavelength filter, merely represent a selection of several straightforward possibilities. An alternative solution by means of bandpass wavelength division units is disclosed in the system of D1 (Fig. 1A: 14, 15 and Fig. 1B: 24, 25).

The use of optical fibers (claim 11) is already disclosed in the prior art (e.g. D1: abstract).

Claims 12-16 merely represent a selection of several well known possibilities. In addition, fiber Bragg gratings are known form D1 (col. 9, lines 40-52) and D2 (page 10- line 18 to page 11, line 11). The use of chirped Moire Bragg gratings is known from the transmission filters of D4 (see abstract).

4. Document D1 (see abstract and Fig. 1A and 1B) discloses (the references in parentheses applying to this document) in accordance with the features of independent claim 17
an optical filter device for multiplexing and de-multiplexing an optical signal having multiple wavelengths, comprising:
a first waveguide (10, 20) and an optical branching means (13, 23) optically connected to said first waveguide, at least second (12, 22) and third (11, 21) waveguides optically coupled to said optical branching means; and at least one odd/even select filter (16, 26) optically coupled to said optical branching means for either (see col. 3, line 9 to col. 4, line 45)
i) splitting an optical signal launched into said first waveguide into its odd and even wavelength components with one of said odd and even wavelength components being transmitted along one of said at least second and third waveguides and the other of said odd and even wavelength components being transmitted through the other of said at least second and third waveguides; or
ii) combining optical signals launched into said second and third waveguides with said combined optical signals being transmitted along one of said first waveguide.

Document D1 discloses all the features of independent claim 17. Thus independent **claim 17 is not new** and does not fulfill the requirements of **Article 33(2) PCT**.

5. Furthermore it should be noted that documents D2 (see abstract and Fig. 9) and D3 (see abstract and Fig. 2) describe dense WDM optical multiplexer and demultiplexer including all the features of independent claim 17.

Re Item VI

Certain documents cited

Certain published documents (Rule 70.10)

Application No Patent No	Publication date *(day/month/year)*	Filing date *(day/month/year)*	Priority date *(valid claim)* *(day/month/year)*
PCT/US99/03981	26/08/99	23/02/99	23/02/98

Re Item VII

Certain defects in the international application

Documents D1-D3, cited in the International Search Report, are not identified in the description and the relevant background art disclosed therein is not discussed in the introductory part of the description, in such a way that the inventive merit of what is claimed can be readily understood (Rule 5.1(a)(ii) PCT).

Independent claims are not drafted in the two-part form in accordance with Rule 6.3(b), with those features known in combination from a prior art document being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

The claims do not include reference signs in parentheses where features shown in the drawings are referred to (Rule 6.2(b) PCT). This applies to both preamble and characterising portion.

Re Item VIII

Certain observations on the international application

The expression "and incorporated herein by reference" on page 9, line 18 of the description is not in accordance with the dispositions laid down in the PCT guidelines PCT/GL/3-II-4.17.

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

TEITELBAUM, Neil
JDS Uniphase Corporation
570 West Hunt Club Road
Nepean, Ontario K2G 5W8
CANADA

Date of mailing (day/month/year)
10 octobre 2001 (10.10.01)

Applicant's or agent's file reference
10-454 PCT

IMPORTANT NOTIFICATION

International application No.
PCT/CA00/00813

International filing date (day/month/year)
13 juillet 2000 (13.07.00)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address
E-TEK ELECTROPHOTONICS SOLUTIONS CORPORATION
2770 14th Avenue
Markham, Ontario L3R 0J1
Canada

State of Nationality: CA
State of Residence: CA
Telephone No.: (905) 946-1336
Facsimile No.: (905) 946-0190
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [X] the address [X] the nationality [X] the residence

Name and Address
JDS UNIPHASE CORPORATION
210 Baypointe Parkway
San Jose, CA 95134
United States of America

State of Nationality: **
State of Residence: US
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
Brigitte WYSS (Fax 338.87.40)

Telephone No.: (41-22) 338.83.38

Form PCT IB 306 (March 1994)

004359790

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 20 March 2001 (20.03.01)	
International application No. PCT/CA00/00813	**Applicant's or agent's file reference** 148-013-P
International filing date (day/month/year) 13 July 2000 (13.07.00)	**Priority date** (day/month/year) 13 July 1999 (13.07.99)
Applicant ALAVIE, A., Tino	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

12 February 2001 (12.02.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Charlotte ENGER
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PA. _NT COOPERATION TREAT

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

TEITELBAUM, Neil
JDS Uniphase Corporation
570 West Hunt Club Road
Nepean, Ontario K2G 5W8
CANADA

Date of mailing (day/month/year)
30 juillet 2001 (30.07.01)

Applicant's or agent's file reference
10-454 PCT

IMPORTANT NOTIFICATION

International application No.
PCT/CA00/00813

International filing date (day/month/year)
13 juillet 2000 (13.07.00)

1. The following indications appeared on record concerning:

[ ] the applicant [ ] the inventor [X] the agent [ ] the common representative

Name and Address

TEITELBAUM, Neil
c/o JDS Uniphase Corporation
Intellectual Property Dept.
1187 Bank Street
Suite 201
Ottawa, Ontario K1S 3X7
Canada

State of Nationality:

State of Residence:

Telephone No.: 613 7271304 ext 2690

Facsimile No.: 613 823 7706

Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address

TEITELBAUM, Neil
JDS Uniphase Corporation
570 West Hunt Club Road
Nepean, Ontario K2G 5W8
Canada

State of Nationality:

State of Residence:

Telephone No.: (613) 727-1304

Facsimile No.: (613) 823-9957

Teleprinter No.:

3. Further observations, if necessary:
Please note that the agent's file reference has been corrected to read 10-454 PCT.

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

F. Baechler

Telephone No.: (41-22) 338.83.38

Form PCT/IB/306 (March 1994)

004182025

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

To:

TEITELBAUM, Neil
JDS Uniphase Corporation
570 West Hunt Club Road
Nepean, Ontario K2G 5W8
CANADA

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

Date of mailing (day/month/year) 10 October 2001 (10.10.01)	
Applicant's or agent's file reference 10-454 PCT	**IMPORTANT NOTIFICATION**
International application No. PCT/CA00/00813	**International filing date** (day/month/year) 13 July 2000 (13.07.00)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address	State of Nationality	State of Residence
E-TEK ELECTROPHOTONICS SOLUTIONS CORPORATION 2770 14th Avenue Markham, Ontario L3R 0J1 Canada	CA	CA
	Telephone No. (905) 946-1336	
	Facsimile No. (905) 946-0190	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [X] the address [X] the nationality [X] the residence

Name and Address	State of Nationality	State of Residence
JDS UNIPHASE CORPORATION 210 Baypointe Parkway San Jose, CA 95134 United States of America	**	US
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Brigitte WYSS (Fax 338.87.40)
Facsimile No.: (41-22) 740 14 35	Telephone No.: (41-22) 338.83.38

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